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This publication gives information on new developments of interest to agriculture on laboratory and field investigations of the du Pont Company and its subsidiary companies.

In addition to reporting results of the investigations of the Company and its subsidiaries, published reports and direct contributions of investigators of agricultural experiment stations and other institutions are given dealing with the Company's products and other subjects of agricultural interest.

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LOSS OF ANTI-FREEZE IN AUTOMOBILE COOLING SYSTEMS DUE MORE TO MECHANICAL CAUSES THAN TO EVAPORATION

EDITOR'S NOTE:- The facts presented here on the loss of anti-freeze solutions were developed in a paper given by Dr. Duus at the meeting of the American Chemical Society, Rochester, New York, September 6-10, 1937.

By Hans C. Duus, Research Chemist,
Du Pont Experimental Station,
Wilmington, Delaware.

Several years ago the du Pont Company introduced synthetic methanol under the trade name "Zerone" as an anti-freeze for automobile cooling systems. Methanol having a boiling point of 149°F., which is lower than that of water, is classified as a "volatile" anti-freeze. Because of this low boiling point there was considerable doubt as to its effectiveness, since it was popularly supposed that it would evaporate from the cooling system leaving a solution with less freezing point protection. It was known that boiling point alone was not a very good measure of its effectiveness, since the boiling point of a methanol-water solution is higher than that of the pure material. Methanol, however, has a decided economic advantage in that considerably less volume is needed to effect a given lowering of the freezing point than is required for any other anti-freeze, volatile or non-volatile. This is because methanol has such a low molecular weight that there are more molecules of anti-freeze in a given volume than in an equal volume of any other commonly available material. Hence, methanol should prove a very desirable anti-freeze. However, the practical effect of the boiling point could not be established until a great number of tests had been made on cars under average operating conditions. About 300 cars have been run in such tests for the past seven years, and the results show that methanol is not lost to any greater extent than water or high boiling anti-freeze in standard cooling systems equipped with 140° thermostats. These tests were carried out in several metropolitan areas throughout the country, and a special series was run at the high altitude of Denver, Colorado, where boiling points are 10° lower than at sea level.

Losses Due Largely to Mechanical Causes

The test data show that about 90% of the losses from a cooling system are due to mechanical causes, such as leaks, thermal expansion of the cooling liquid, forward surges of the liquid on sudden stopping, the carry-over of fine spray by the violent agitation in the cooling system. A further important source of loss is the "after-boil" which occurs when the engine is shut down after a hard run, and is caused by the heat stored up in the engine block. Mechanical losses obviously effect no separation of anti-freeze. Evaporation accounts for only 10% of the total loss and causes only a slight change in freezing

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point protection--a fact which is readily understood when it is recalled that an automobile radiator was not designed to act as a still and can consequently not separate anti-freeze from water very effectively.

The method used in demonstrating the importance of mechanical losses and the insignificance of evaporation losses was very simple. Test cars were serviced from a stock solution of "Zerone" having a freezing point 10°-20°F. below the lowest expected temperature. During the test period, usually six months, and never less than one month, all losses were replaced with the same stock solution. At the end of the tests the freezing points were found to be substantially the same as at the beginning. Maintenance of freezing points with the procedure used in making up losses would not have been possible unless these losses were mainly mechanical. Check runs made simultaneously on an anti-freeze of high boiling point gave the same result, namely, that freezing points could be maintained only by adding solution. Consequently it was concluded that the best practice for the motorist to follow is to make all replacements with solution rather than to add straight water which decreases his protection, or with straight anti-freeze which gives him over-protection and wastes his anti-freeze by mechanical losses.

"Zerone" is a trade name registered in the United States Patent Office by E. I. du Pont de Nemours & Company, Inc.

INSECT PESTS AND THEIR CONTROL OFFER A BROAD FIELD FOR STUDY AND THE DEVELOPMENT OF REMEDIAL MEASURES

EDITOR'S NOTE:- This article was prepared by the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, Mr. Lee A. Strong, Chief. It is reprinted from "Technological Trends and National Policy", a report of the Sub-committee on Technology to the National Resources Committee. The Honorable Harold L. Ickes, Secretary of the Interior, is chairman.

Insect pests affect man's every activity. They destroy his food plants, his livestock, his clothing, his buildings, and indirectly through insect-borne disease, affect man himself. In the United States alone the annual tax paid to insect pests attacking agricultural crops and livestock often amounts to over 2 billion dollars. The cotton boll weevil, for example, destroys an average of nearly 2 million bales of cotton every year; the hessian fly takes an average annual toll of 48 million bushels of wheat.

Scope of Insect Control Work

The most conservative estimates give the number of insects as about 4,500,000, of which only 750,000 have been described. Not all of these are detrimental to man. Some, such as the honeybee and those which prey on other insects, are beneficial. The destructive and annoying kinds number hundreds of thousands, however.

More than 7,000 species cause economic losses to crops in the United States. The habits and hosts of these all differ and controls vary with the kind of pest, region, and crop. The methods employed include the use of natural enemies, the adaptation of modifications in crop practices, the determination of tolerant or resistant varieties of crops, the use of mechanical devices, the use of poisons, attractants and repellants -- in fact any device, material or agency which can be economically applied. In the use of insecticides alone developments in economic entomology have brought the control of insect pests from hand-picking and the sprinkling of a simple insecticide with a whiskbroom to the high-powered sprayers that reach the highest shade trees and the permanently installed spraying equipment by which several hundred acres of orchards can be treated from a central spray plant, and the airplane duster, that can cover several cotton plantations in one day.

The field of insect control is very broad. It requires an extensive and specialized technique and the use of detailed knowledge in many fields of endeavor and science. To coordinate and use these effectively to a common end requires detailed planning. There is the intricate technique of rearing the insect to

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determine its habits, responses, and hosts; the development of ways of producing insect parasites under artificial conditions, of transporting these parasites sometimes half way around the earth, of cultivating these insects as pure cultures, and of successfully introducing them to the field. The work on bee culture requires specialized technique in handling the bees, in studying honey quality, wax production, and the artificial insemination of queens to produce improved varieties. The devising of mechanical and chemical ways of combating insect pests, such as the development of practical traps or new insecticides; improving and adapting spraying and dusting equipment to special agricultural practices and insect conditions; devising fumigation tanks, steam sterilizers, refrigeration plants, and other devices for treating plants and plant products to free them of insect pests at the ports of entry in order that their introduction may not serve as a means of establishing in this country noxious pests from foreign lands involves the use of highly specialized technique.

Even brief description of the steps involved in developing various methods and planning operations for the control of insect pests would require many pages. Such a discussion would include reference to the principles involved and the technique used in the development of methods and programs; an explanation of the mechanics in making results available for application by individuals and governmental agencies.

The control of insect pests is increasing in complexity. The achievements of the past give assurance of future developments to meet ever-changing conditions. The constant development and change in agriculture and improvement of public health accompanied by the ever-increasing insect consciousness contribute to the complexity of the problem of insect control. The placing of large areas under cultivation and erecting cities and towns have contributed to making favorable environments for insects which in earlier times were of little importance. The rapid development of methods of transportation materially increased the opportunities for dangerous pests being transported to new areas.

The vision of the entomologist is being modified to meet these changing conditions. Lines of investigation little thought of in the early days are under way and basic studies on environmental influences have been begun. That the work on insecticides will develop materials effective against insects attacking food products without leaving residues hazardous to the consumer seems only a matter of time. Who can say that more intimate knowledge of the environment favorable to grass-hoppers will not permit some slight adjustment such as the elimination of some plants favorable in the development of grasshoppers which are of little importance as crops that will prevent general outbreaks of these pests.

Full understanding of the effect of radiations on insects may lead to the development of controls for many pests of households and storages without resorting to control measures now used requiring the application of powerful gases with accompanying health hazard.

TREATMENT OF SUGAR-BEET SEED WITH DISINFECTANT SHOWN TO INCREASE STAND AND YIELD IN MINNESOTA

EDITOR'S NOTE:- This is reprinted from Circular 57, University of Minnesota Agricultural Extension Division. The circular was prepared by Dr. E. L. McClerg, division of Sugar Plant Investigations, Bureau of Plant Industry, United States Department of Agriculture, in co-operation with the Department of Plant Pathology and Botany, Minnesota Agricultural Experiment Station.

Damping-off or "black root" is the principal cause of poor stands of sugar beets in Minnesota and may be caused by at least three different fungi which kill the seedlings either before or after they emerge from the soil. The blank spaces in the drill row are a common early manifestation of the disease. Later, if conditions favor the damping-off fungi, clumps of seedlings may topple over and the disease may spread from plant to plant along the row for several feet. These effects are caused by the various forms of attack by the damping-off organisms. Attack as the seed is germinating may prevent the seedling from getting above ground. Attack in plants that have emerged may be localized on the underground stem which becomes shrunken, usually at the surface of the soil, and so weakened that the young plant topples over. Commonly the roots are attacked as well as the underground stem. Diseased roots become black and soon cease to function. The entire seedling may become stunted and abnormally deep green in color. This well-known condition has been called "Black Root." Such diseased plants soon dry up and disappear.

Previous Crop and Soil Conditions Influence Damping-Off

This disease is usually most destructive in the early plantings on moist soils. Damping-off fungi are almost universally present in soils and probably persist for years, even in the absence of sugar beets. Crop rotation and other cultural practices undoubtedly can do much to reduce disease losses and improve stands.

A crop rotation that provides a long interval between beet crops is highly desirable for many reasons. The crop immediately preceding the beet crop has been shown to have a very definite influence on prevalence of damping-off. Damping-off is commonly serious when sugar beets immediately follow alfalfa or sweet clover and is usually less severe when beets follow corn. The small grains, beans, and potatoes take an intermediate position in their influence on prevalence of damping-off.

Damping-off is less prevalent on well-drained soils. Cultivation as soon as the drill rows can be followed does much to lessen damage.

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Seed Treatment Pays

Experience in Minnesota and in other states has shown that, as a supplement to these beneficial procedures, there is a definite place for sugar-beet seed treatment as a means of improving stands by protecting the young plant in the early period of its growth.

The following results were obtained from experiments made in Minnesota to determine whether stands could be improved by seed treatment. Ceresan* seed disinfectant (not to be confused with New Improved Ceresan) was applied at the rate of 3 to 4 ounces to 20 pounds of seed. Tests have been made both in experimental plots and commercial fields.

Table 1. Number of Seedlings, Before Thinning, in 100 Feet of Row in Seed-treatment-plot Experiments Made in Minnesota from 1933-1935, Inclusive

	1933	1934		1935		
Kind of seed	St. Paul	St. Paul	Waseca	St. Paul	Waseca	Average
Treated	519	477	306	1,489	2,806	1,119
Non-treated	121	410	246	656	1,834	653

The results of tests made in experimental plots from 1933 to 1935, inclusive, are given in Table 1. Better stands were obtained with treated seed than with non-treated seed in every test. The difference between stands from treated and non-treated seed varied in different years, probably due to weather conditions. The increase due to treatment was less in 1934 than in the other two years, probably because of the hot and dry weather which prevailed at St. Paul and Waseca following planting. The dry soil and drying winds in 1934 were very unfavorable for the damping-off fungi as well as for the germination and growth of sugar beets. Nevertheless, the average seedling stand before thinning was 41.6 per cent greater in plots planted to treated seed than in those planted to non-treated seed.

In 1935, lots of treated seed, each weighing 25 pounds, were sent to 20 growers.** The treated seed was planted by the growers under the same conditions as non-treated seed of the same variety. In four of these fields the seedling counts were made before thinning, and the results are given in Table 2. Since hill-drop drills were used in all of the fields, the average number

*The use of Ceresan in these experiments does not imply that other dusts on the market might not be equally effective in controlling damping-off of sugar beets under similar circumstances. The mention of the trade name of this dust does not imply any recommendation of the product.

**These tests and those in 1936 were made by Mr. P. T. Robinson of the American Crystal Sugar Company at Chaska, Minnesota, and the writer made the seedling stand counts and yield determinations.

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of seedlings per hill is used as a basis of comparison of treated and non-treated seed. The stands were usually better from treated seed than from non-treated seed, the average increase in the four tests being 29.2 per cent. In the field of R. H. Beery at Hutchinson, Minnesota, the stand from the non-treated seed was so poor that it was replanted before seedling counts were made. In all trials the seedlings from the treated seed were larger and more vigorous than those from the non-treated seed.

Table 2. Percentage Distribution of Sugar-beet Seedlings Before Thinning from Treated and Non-treated Seed Sown in Commercial Fields with a Hill-drop Drill

No. of seedlings per hill	Percentage distribution of hills									
	John Rice, Hector, Minn.		Ed. Kleman, Fairfax, Minn.		W. Johnson, Lafayette, Minn.		E. Barneke, Madison Lake, Minn.		Average	
	Treated seed	Non-treated seed	Treated seed	Non-treated seed	Treated seed	Non-treated seed	Treated seed	Non-treated seed	Treated seed	Non-treated seed
0	14.8	6.8	0.4	5.4	5.0	7.3	6.4	12.7	6.6	8.0
1	4.5	4.5	0.4	3.6	5.4	6.8	3.2	10.4	3.4	6.3
2	11.4	4.5	1.4	8.6	5.0	4.5	7.3	16.4	6.3	8.5
3	8.0	10.2	1.4	5.0	5.4	6.8	7.7	12.7	5.6	8.7
4	6.8	12.5	0.4	9.5	3.6	8.2	11.4	11.4	5.6	10.4
5	10.2	9.1	1.4	6.8	6.4	8.6	11.4	8.6	7.4	8.3
6	1.1	10.2	1.8	8.6	7.7	5.9	8.2	7.7	4.7	8.1
7-10	19.3	20.4	29.1	19.5	28.6	25.0	29.5	15.0	26.6	20.0
11-20	22.7	20.4	46.4	32.3	29.5	25.9	15.0	5.0	28.4	20.9
over 20	1.1	1.1	17.3	0.4	3.2	0.9	0.0	0.0	5.4	0.4
Av.per hill	6.2	6.6	14.9	7.1	8.4	7.4	6.3	4.0	8.9	6.3

The number of blank hills (hills without seedlings) and the percentage of hills with various numbers of seedlings determines to a large extent the stand after thinning. From Table 2 it appears that the number of blank hills was greatest where non-treated seed was sown. The plantings from treated seed have fewer one-, two-, three-, and four- seedling hills and a larger number of hills containing more than four seedlings.

In 1936, treated seed was distributed by the sugar company to a number of growers and data were taken on the stands and yields in three of the fields. In all cases the stand was better when treated seed was used (see Table 3). There was an average increase of 86.4 per cent in stands before thinning and an increase of 31.3 per cent in stands at harvest time. Yields were greater with treated seed in all three tests, the average increase being 1.6 tons an acre or 17.0 per cent. Thus it appears that in these tests the stands before thinning, the percentage stands at harvest, and the yields were increased

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materially by the use of treated seed. It should be noted, however, that increases in tonnage may not always occur even tho the percentage of stand after thinning is greater with treated seed. Such would be the case in very dry seasons where the roots in the smaller percentage stands would become proportionately larger, since they would have more area of land, and consequently more moisture per root, than those in the higher percentage stands.

Table 3. Number of Seedlings in 100 Feet of Row Before Thinning, Percentage Stand Before Harvest, and Yield in Tons of Sugar Beets in Farmer's Field Tests Made in 1936

Kind of seed	Owner of field: Mrs. Ida Beneke, Glencoe, Minn.	E. Malchow, Biscay, Minn.	H. J. Meieres, Stewart, Minn.	Average	Percentage increase due to treatment
Seedling stand before thinning					
Treated	1,591	988	1,136	1,238	86.4
Non-treated	853	534	604	664	
Percentage stand at harvest					
Treated	63.5	70.4	80.1	73.5	31.3
Non-treated	61.7	42.8	73.0	56.0	
Yield in tons					
Treated	13.4	10.3	9.3	11.0	17.0
Non-treated	10.1	9.9	8.3	9.4	

Method of Treating Seed

Recommendation as to the quantity of any commercial seed disinfectant should be followed as printed on the label of the container. Enough dust should be used, however, so that every seed ball is thoroughly covered with a thin coating of dust. Every lot of seed should be rotated in the mixer 20 to 25 times. For small quantities of seed, a home-made duster made on the principle of a rotating barrel churn in which baffle boards have been placed may be used. Special seed-treating machines are on the market for treating large quantities of seed.

Caution

Many of the seed-treatment compounds are poisonous and should not be inhaled. Always wear a dust mask or cover the nose and mouth with several layers of folded cloth while treating seed. Face and hands should be washed thoroughly immediately after working with these dusts, as some of them may irritate the skin. Whenever possible, treating should be done in the open air or in a well-ventilated place.

"Ceresan" is a trade name registered in the U. S. Patent Office by the Bayer-Semesan Company, Wilmington, Del.

THE ESSENTIAL REQUIREMENTS OF GAME COVER EXPLAINED AND MEANS TO IMPROVE EXISTING CONDITIONS SUGGESTED

EDITOR'S NOTE:- One of the country's leading writers on outdoor subjects tells here some definite and practical things which can be done to improve conditions for wildlife on farms. The subject is one of particular importance to individuals and agencies interested in a valuable national resource.

By Robert Page Lincoln

It is a sad reflection on our sense of good judgment and knowledge of the requirements whereby game birds may be perpetuated that there is, as yet, but little definite understanding among the sportsmen and farmers of the value of real cover for the game birds. This cover is subject to the physical nature of the region, the lay of the land, its natural weed, brush, or tree growth not to forget that what applies to the needs of one species of game bird is not necessarily the choice of another. Indirectly each game bird and its requirements must be considered separately, although it is true that what one demands another may also find entirely to its liking.

Upland game, of which the pheasant is now the leading exponent, is dependent upon farm lands for its feeding grounds as well as cover in which to hide and to nest. Needless to state its future depends to a great extent upon the willingness of the farmer to reserve cover on his land for the purpose and to share with this dominant game bird a certain portion of the food that is produced on the land. There is no gainsaying the fact that the farmer, in the final analysis, feeds the game birds. Without this food there would be no hope for the pheasant or any other bird.

Lack of Cover for Pheasants

It is extremely doubtful if the rank and file of the farmers leave a judicious amount of cover on the land with the object in view of perpetuating this game bird. There are wild-run pasture lands, strips of brush and tall weeds along watercourses and ditches, small nooks at fence corners and along the fence rows themselves on which these birds must depend. Choicest of all probably is the meadow patch of willow, kinnickinic, swamp grasses and coarse weeds in general. Often these patches will be quite extensive, ranging in fact from an acre to ten or more acres in extent. The farmer rarely touches an area of the sort inasmuch as it is quite damp at times, is left for pasture, is excellent for the cattle in the heat of the summer and is probably useful for no other purpose. Obviously the farmer is not intentionally reserving this patch for the game birds, and yet here is to be found about the finest cover in the world for the pheasant, not to mention the prairie chicken. Several years ago

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we made a check on a certain ten-acre tract such as mentioned, with really amazing results. Here were produced more than 30 pheasants, there were 10 prairie chickens there in the fall, something like 10 of the almost rare woodcock, several partridges in a wooded stretch near its further end. Here, too, were produced what I should judge to be upwards of 20 cottontail rabbits, while a pond in one end produced a number of muskrats. Several mink and one raccoon were listed among the inhabitants of this lowland strip. Songbirds to the extent of twenty species nested in this area.

Game Protected During Summer

Now the above example of farm cover is interesting inasmuch as it shows just what is possible on even the smallest areas on the farm lands. Understand, this instance may be considered as unusual for the very reason that this farmer's land was summer-posted, and was not invaded at any time by boys and others. By very reason of the fact that this tract was left quite at its lonesome and nothing appeared to disturb the various game birds, they nested under conditions that were well nigh comparable to that of the wild state!

Obviously there are thousands of like stretches of lowland cover on the farms of the country, some good, some indifferent, some of little use. Yet it is these so-called waste pieces of cover that we must consider seriously in our survey of the subject. They are the logical breeding and sheltering places on the farms. A great number of these would provide an abundance of game, ten times more than now in some instances, were they properly set aside and all intruders kept out of their confines. Where farmers have the future of the game fully at heart, it would be possible to have such areas posted to the extent that there would be no invasion of their confines at any time in the course of the summer. Probably the efforts of the farmer in this respect would be disregarded, but not so if a state game and fish department stepped in and officially established such locations as breeding areas. This would demand first, a survey of each township in a country and cooperation of the farmers. Where these tightly brushed in and weedy lowland areas are found to be suitable they would at once be set aside as breeding places and official game cover. Thus set aside and all invasions by boys and others shut out, it would be found that the game birds would remove to such places in great numbers.

Work for 4-H Club Members

While these larger patches of lowland cover provide the best that the farms have to offer, there are also little islands of brush and wooded areas, certain to carry a number of pheasants. The struggle in the future will be to preserve such, and also any waste places in their entirety, but this is entirely as the farmer wills it. If, as is true in some sections of the country, the farmer derives some manner of revenue from the hunter as the result of furthering or perpetuating the game bird on his land, then that is an answer to the problem. The plan may not be fool proof, nevertheless it has worked out advantageously in many states. On the other hand where there is yet no revenue derived by the farmer for his efforts and he still is the "sole support" so far as the game

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on his land is concerned, we have another angle to consider. That angle involves the farm boys and girls who have become enrolled in the conservation units of the 4-H Clubs of the country. Is it not logical to believe that these farm boys and girls, who are really just next door to the breeding and feeding places of the upland birds, should be the ones who could work wonders, not only in ascertaining these thousand and one desirable farm covers, but who could, at the same time, post and protect such in the summer and who could likewise enumerate the game species on the same? Of course. It can be said without contradiction that the future of a very great number of our game birds on our farms will depend upon the disposition of the game cover on the same and to what an extent the young people on the farms will aid in protecting the same.

If the future holds in store a more intense use of the acres and "clean farming" will be pushed, thus wiping out available cover, the game birds must go. No cover, no feeding and breeding areas, no game birds!

"STUMP CRIBBING" PROVIDES NEW PROTECTION FROM DAMAGE WHEN STUMPS ARE BLASTED WITH DYNAMITE NEAR BUILDINGS

EDITOR'S NOTE:- The procedure for guarding against property damage, described in this article, is a development of no little importance. Mr. Livingston is largely responsible for evolving the method, and has supervised a number of jobs which were done under very exacting conditions.

By L. F. Livingston, Manager,
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Wilmington, Delaware.

Blasting to remove stumps near buildings has always been a problem for even the most experienced blasters. While the methods employed have varied, a satisfactory means of doing the work without probability of some degree of damage being done was not evolved until "stump cribbing" was developed. Even this method was not to be recommended until after many experiments, extending over many years, had demonstrated its feasibility. Now, however, stump cribbing can be successfully practiced, provided the work is done by a thoroughly competent blaster.

The advantage of cribbing is at once evident because of the fact that stumps have been taken out as near as 20 feet to structures with ordinary foundations. Where a building is supported by substantial piers, blasting may sometimes be done to within six feet of the structure.

In doing stump cribbing, loading is done in the usual approved ways; that is, with two or more holes under a stump with spreading roots, or a single charge inserted in a tap-root, for a tap-root stump.

But it is very important that the charges of dynamite be placed approximately 25 per cent deeper than ordinarily. This requires slightly heavier charges, yet over-loading must be guarded against. The reason for deeper loading is to provide a greater "cushion" of earth above the "shot".

Conditions may require that instead of attempting to blow out a stump with a single shot that the work be done with two or more blasts.

How a Stump is Cribbed

After loading, the stump is completely and thickly covered with sturdy brush. The thickness of the brush "mat" is never less than 12 inches at all points, and usually is thicker than that. As an additional precaution, meshed wire fence material is sometimes spread on the top and sides of the brush. This is laced together with strong wire. Then, a pyramid of logs is constructed over

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the pile of brush. Old railroad ties, if sound, are excellent for the purpose. Next, a strong chain is looped around the logs and the ends of the chain are securely joined. Where a chain is not available, a heavy wire cable is substituted. Care is taken not to have the chain or cable too tight. Seldom, if ever, is a chain or cable broken by a blast.

For a better un erstanding of the need for cribbing stumps in the vicinity of buildings, it is to remind blasters that an explosion of dynamite has two actions -- a breaking or rending, one followed by a heaving action. Both of these actions are exerted equally in all directions, but follow the line of least resistance.

When cribbing is done properly, the brush serves as a cushion to absorb the shock of the breaking action of the explosion not cushioned by the soil. Therefore, only the slower heaving action -- the part not dissipated in lifting the stump and the soil -- is exerted on the log pyramid. The weight of the logs keeps the heaving action of the blast from throwing either the pieces of brush or fragments of stump and thereby prevents damage from these sources being done.

Avoiding Damage from Ground Shock

Although cribbing a stump can obviate damage from flying fragments, cribbing does not control ground shock caused by the flow of an explosion wave. The resultant vibration is capable of great damage when heavy. In this connection, it should be kept in mind that wet ground transmits shock very much more readily than does dry earth. This, of course, suggests that in some instances it is better to do shooting when the soil is dry, despite the fact that blasting stumps in wet soil offers well-known advantages.

It is further to note that a stratum of rock is potent medium for the transmission of the shock of an explosion. Therefore, it is exceedingly important that soundings be made to determine whether rock under a stump which is to be blasted extends to, or under, the foundation of a nearby structure. Where rock is present, extreme precautions must be observed.

Because shooting near a building always involves a degree of hazard, it is strongly suggested that the blasting be done only by those whose skill and experience make them competent.

When blasting is being done, the occupants of a building should leave it until after the operations are completed. Farm animals also should be removed from structures near to where blasting is to be carried on.

Finally, all the customary safety rules for using explosives must be adhered to strictly in stump cribbing as in all other cases of blasting.

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